

## Founder Effects in Some Victorian Wild Rabbit *Oryctolagus cuniculus* L. Populations

Rosamond C.H. Shepherd<sup>1</sup> and J. W. Edmonds<sup>2</sup>

### Abstract

The founding rabbits on most Victorian islands were domestic-types and the domestic characteristics can still be readily observed. Although Thomas Austin's releases of agouti rabbits at *Barwon Park* near Winchelsea were the main progenitors of the present wild rabbit populations, founder effects from other local releases can still be detected. Evidence for this is shown by genetic differences still observable in today's populations. These genetic differences were introduced with the original rabbit populations. (*The Victorian Naturalist* 113 (3)1996, 98-101)

### Introduction

This study formed part of the background research into the myxomatosis/rabbit interaction continued over the period 1950-1985. This research was carried out by the staff of the Keith Turnbull Research Institute, Department of Crown Lands and Survey (with its various name changes), and one of its investigations was the genetic origin of the wild rabbit *Oryctolagus cuniculus* L. populations in Victoria.

Until about 1970 it was generally accepted that, although island populations of rabbits often had widely different characteristics, there was little variation within mainland populations. This was because their dominant progenitors, especially in Victorian populations, were a small number of wild-type rabbits from *Barwon Park* near Winchelsea (Fig. 1) (Rolls 1969). These wild-type rabbits (agouti, commonly called grey) were part of a consignment obtained from England by Thomas Austin which either escaped or were released in 1860 (Rolls 1969).

The persistence of characteristics of the original rabbits, *founder effects*, can be readily observed in island populations, but there has been no detailed investigation in mainland populations. In this paper we discuss some island rabbit populations and consider some apparent founder effects in mainland populations and their possible origins.

### Island Populations

The first recorded release of rabbits on a Victorian island was by Commander Stokes in H.M.S. *Beagle* in June 1842. About 12 rabbits were released on Deal Island (Fig. 1). Later releases were made on several other Bass Strait islands (Edmonds *et al.* 1976).

Descriptions of these island rabbits refer mainly to colour and size. A colony of about 20 black rabbits was founded on Doughboy

Island before 1900, but was apparently wiped out by myxomatosis (J. Sparkes, Inspector, Department of Crown Lands and Survey *pers. comm.*). From Rabbit Island, Norman (1970) reported 3000-4000 long-eared, black-blue rabbits which were the size of domestic-rabbits, i.e. larger than mainland rabbits, and a few grey rabbits. Rabbits on Sunday Island were multi-coloured and also large; on Saint Margaret's Island, where the rabbits could travel to and from the mainland at low tide, there were some black and some orange rabbits amongst the mostly wild-type or agouti coloured population (D. Mitchell, Inspector, Department of Crown Lands and Survey *pers. comm.* 1975).

A Mr. Griffith may have released two agouti rabbits on Lady Julia Percy Island in 1848 (Fig. 1) (the late G.W. Douglas, Vermin and Noxious Weeds Destruction Board, *pers. comm.* 1980). However, Pescott (1965) reported that wild rabbits were introduced to Lady Julia Percy Island in 1868. Neither of these reports has been substantiated. The population on Mud Island in Port Phillip Bay was thought to have been founded by wild agouti rabbits introduced in about 1926 from the neighbouring mainland (D. Venn, Ranger, Department of Conservation and Environment *pers. comm.* 1982).

The Churchill Island population is a special case. Following a mortality rate greater than 99% from myxomatosis in 1952-1953, domestic-type rabbits were released and maintained as a feral population (Edmonds *et al.* 1981). The domestic characteristics of colour and large size persisted until eradication programs were carried out by the Department of Crown Lands and Survey during the 1980s.

### Mainland rabbits

The first feral rabbits in Victoria were domestic-type escapees in Melbourne in 1837 (Stead 1935). It is believed that none of these survived for more than a short time.

<sup>1</sup> 6 Idon Avenue, Frankston, Victoria 3199.

<sup>2</sup> 515 Willowite Road, Moriac, Victoria 3240.



Fig. 1. Map of Victoria showing rabbit release and collection sites.

The first established population seems to have been in the coastal dunes between Portland and Port Fairy during the 1850s (Woodfield 1967). These rabbits were of unknown origin. Other recorded feral populations, which pre-dated the *Barwon Park* release, were on the central Victorian gold-fields, at Morton Plains in the Mallee (Fig. 1) and in the southern Wimmera near Goroce (Fig. 1). The rapid spread of wild-type rabbits from *Barwon Park*, Winchelsea, apparently overwhelmed any pre-existing populations. Some of the spread from *Barwon Park* was deliberate for the first 3-4 years. The next deliberate release in that district was probably after the myxomatosis epizootics of the early 1950s when wild-type rabbits were released in order to maintain a population for historical reasons (Anon. *pers. comm.*). We have no evidence of any other organised releases on the mainland after 1875.

#### Data Collection

Coat colour was recorded in the field by both live observation and from shot samples. Rabbit size and weight (g) were recorded from shot samples as part of a wide ranging investigation of Victorian wild rabbit populations (Shepherd 1985, Shepherd and

Edmonds 1976). A one year study (1979) in the Mallee ( $n=357$ ) gave an average weight of 1470 g for mature rabbits i.e. >110 days old, whereas, mature domestic rabbits are in the 2000 g range.

Sera were collected for a study of structural differences in rabbit antibodies (immunoglobulins). They were tested for immunoglobulin (Ig) allotypes whose structure is controlled by co-dominant alleles (different forms of a gene) of immunoglobulin structural genes. The alleles tested for were the Aa locus alleles,  $a^1$ ,  $a^2$  and  $a^3$  on the Ig heavy chain and the Ab locus alleles  $b^1$ ,  $b^2$  and  $b^3$  on the Ig light chain. All tests were by antibody antigen reactions in gel as described by Herd and Edmonds (1977).

#### Results and Discussion

Although it is generally accepted that Austin's release of wild-type rabbits at Winchelsea provided the main founders for the present mainland populations (Rolls 1969), it is known that other releases have been significant contributors in some coastal areas and on some islands (Edmonds 1977; Edmonds *et al.* 1981; Herd and Edmonds 1977). Differences between island populations could be the result of either founder

effects or differential selection effects on different islands. The rate of evolutionary change in the Australian wild rabbit has been sufficient to allow differences in colour and body conformation between temperate and arid zone rabbits, and also in rabbits under stress of high population density pressure (Myers 1966; Myers 1970); rabbits from the arid zone have yellower coats (Stodart quoted in Myer 1970), and rabbits from warmer regions have significantly longer extremities, both ear length and foot length are longer in sub-tropical and arid zones than in the sub-alpine and Mediterranean zones (Myer 1970).

	Subtropical	Subalpine
Ear length (mm)	82.05	77.64
Foot length (mm)	92.01	89.38

In Victoria the most readily apparent example is selection for black colour in montane forest fringes, where black favours protection from predation. This colour was selected from the genetic pool available in the wild rabbit population (Edmonds *et al.* 1976). The possible occurrence of selection pressure must be allowed for in any consideration of founder effects (Shepherd and Edmonds *unpubl. data*).

The characteristics being considered, coat colour and size, may be under widely different selection pressures, even if the most severe pressure is thought to be predation by raptors and foxes. Founder effects for both colour and size have been recorded for several Gippsland populations including those on Churchill Island, St. Margaret's Island and Sunday Island and the coastal strip near these islands (Edmonds *et al.* 1976). We found no evidence that domestic-type genes for colour or for weight had spread far beyond the coastal strip. Populations sampled from agricultural land at Bemm River (n=23), Seaspray (n=233), Swilts Creek (n=55), Moe (n=53), Cobungra (n=104) and Negoura (n=64), and from Wilson's Promontory were wild-type in colour and size.

All rabbits from Lady Julia Percy Island (128) were agouti but mean weight (1080 g) was less than that for mainland wild rabbits. Grasses and other vegetation were sparse and dry at the time of collection. These rabbits were also smaller than the mainland rabbits. The smaller size could be either a selection or a founder effect. In either case the suggestion that the founding population was two agouti rabbits could be correct. Although the

domestic rabbits available in the 1850s were large and mixed in colour they generally failed to establish in the wild (Rolls 1969). Perhaps Mr. Griffith was a percipient selector of rabbits and had collected his two agouti rabbits from the coastal dunes. It is, of course, possible that there were subsequent unacknowledged introductions of wild rabbits from the mainland.

Of a sample of 60 rabbits from Mud Island, 52 were agouti, six ginger and two black. These rabbits were within the weight range for mainland rabbits. The Mud Island population could have been founded by the release of rabbits from the mainland if these founders had been selected for colours with subsequent selection not being affected by terrestrial predators which tend to select out the more obvious colours. Genes for colour would then persist in the population.

The only evidence we have found for the survival of a probable domestic gene for colour in the agouti rabbits of the northern and western plains of Victoria, is from Morton Plains in the Mallee, where the occurrence of albinism is higher than in any other population we have observed. Although a spot collection is inevitably biased towards albinos our collection of 11% compares with 2.2% for rabbits collected near Donald (n=47) and 0.0004% in 6693 rabbits collected over 10 years in other north-western Victorian districts. There is no apparent reason why selection for albinism should have been greater at Morton Plains than elsewhere in north-western Victoria. It is likely that its high occurrence there is a founder effect from the domestic-type feral population established during the 1860s. We have found no evidence of any significant variation in the infrequent occurrence of colours other than agouti or albino in the northern or western plains rabbits.

In following up a survey of immunoglobulin allotypes (Edmonds 1977, Herd and Edmonds 1977) we have found that the order of frequencies of the Ab locus alleles on Lady Julia Percy Island,  $b^0 > b^1 > b^2$ , is unique in Australian rabbits and the  $b^0$  frequency (0.40) is the highest recorded (Edmonds and Shepherd *in prep.*). Such an apparent founder effect could have occurred with a small number of agouti rabbits but it is most unlikely that they could have been taken by chance from a population resembling the present mainland population. If the founding date, which is believed locally to be 1848, is cor-

rect, then it is also unlikely that the island population was supplemented with any significant number of wild rabbits from the mainland after the Winchelsea rabbits. These have a high  $b^4$  allele frequency, and established themselves across south-western Victoria. Only speculation on the origin of these rabbits is possible now.

A population sampled between Edenhope and Goroke could be distinguished from other Wimmera and neighbouring South Australian populations by a high  $b^5$  frequency (0.52), the highest recorded on the mainland. The next highest  $b^5$  frequency was 0.38 in a sample collected about 40 km east of Edenhope (Edmonds and Shepherd *in prep.*). The local belief that a wild rabbit population was established in about 1870 may be correct but its origins remain unknown. It could have been a small local release of Winchelsea rabbits which, by chance, had a high  $b^5$  frequency.

The  $b^9$  allele was not found in Gippsland (Herd and Edmonds 1977). We have attempted to determine the limits of the presence of the  $b^9$  allele (Fig.1) which has not been found on the mainland east of Frankston and south of the Dividing Range. It is now present near Frankston, possibly as a result of the establishment of experimental rabbit colonies during the 1970s. It is also now present on Phillip Island, almost certainly by migration from Churchill Island across the causeway connecting the two islands.

### Conclusions

There is no doubt that Thomas Austin's wild rabbits, released at *Barwon Park* and which included wild rabbits (Rolls 1969), were the main progenitors of Victoria's wild rabbit populations. The massive spread of rabbits began from there (Rolls 1969), since it is the only evidence for the release of wild rabbits in Western Victoria that could have contributed so greatly to the gene pool. There is no other supporting data for this massive spread, beyond the thousands of wild rabbits seen, and the initial spread reported from *Barwon Park*. However, some of the small releases of rabbits outside that area have made persistent contributions to the mainland gene pool.

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